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XXXI. *On the Digestion of the Stomach after Death*, by John Hunter, F. R. S. and Surgeon to St. George's Hospital.

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AN accurate knowledge of the appearances in animal bodies that die of a violent death, that is, in perfect health, or in a sound state, ought to be considered as a necessary foundation for judging of the state of the body in those that are diseased.

But as an animal body undergoes changes after death, or when dead, it has never been sufficiently considered what those changes are; and till this be done, it is impossible we should judge accurately of the appearances in dead bodies. The diseases which the living body undergoes (mortification excepted) are always connected with the living principle, and are not in the least similar to what may be called diseases or changes in the dead body: without this knowledge, our judgment of the appearances in dead bodies must often be very imperfect, or very erroneous; we may see appearances which are natural, and may suppose them to have arisen from disease; we may see diseased parts, and suppose them in a natural state; and we may suppose a circumstance to have existed before

fore death, which was really a consequence of it; or we may imagine it to be a natural change after death, when it was truly a disease of the living body. It is easy to see therefore, how a man in this state of ignorance must blunder, when he comes to connect the appearances in a dead body with the symptoms that were observed in life; and indeed all the usefulness of opening dead bodies depends upon the judgement and sagacity with which this sort of comparison is made.

There is a case of a mixed nature, which cannot be reckoned a process of the living body, nor of the dead; it participates of both, inasmuch as its cause arises from the living, yet cannot take effect till after death.

This shall be the object of the present paper; and, to render the subject more intelligible, it will be necessary to give some general ideas concerning the cause and effects.

An animal substance, when joined with the living principle, cannot undergo any change in its properties but as an animal; this principle always acting and preserving the substance, which it inhabits, from dissolution, and from being changed according to the natural changes, which other substances, applied to it, undergo.

There are a great many powers in nature, which the living principle does not enable the animal matter, with which it is combined, to resist, viz. the mechanical and most of the stronger chemical solvents. It renders it however capable of resisting the powers of fermentation, digestion, and perhaps several others, which are well known to act

act on this same matter, when deprived of the living principle, and entirely to decompose it. The number of powers, which thus act differently on the living and dead animal substance, is not ascertained: we shall take notice of two, which can only affect this substance when deprived of the living principle; which are, putrefaction and digestion. Putrefaction is an effect which arises spontaneously; digestion is an effect of another principle acting upon it, and shall here be considered a little more particularly.

Animals, or parts of animals, possessed of the living principle, when taken into the stomach, are not the least affected by the powers of that viscus, so long as the animal principle remains; thence it is that we find animals of various kinds living in the stomach, or even hatched and bred there: but the moment that any of those lose the living principle, they become subject to the digestive powers of the stomach. If it were possible for a man's hand, for example, to be introduced into the stomach of a living animal, and kept there for some considerable time, it would be found, that the dissolvent powers of the stomach could have no effect upon it; but if the same hand were separated from the body, and introduced into the same stomach, we should then find that the stomach would immediately act upon it.

Indeed, if this were not the case, we should find that the stomach itself ought to have been made of indigestible materials; for, if the living principle was not capable of preserving animal

substances from undergoing that process, the stomach itself would be digested.

But we find on the contrary, that the stomach, which at one instant, that is, while possessed of the living principle, was capable of resisting the digestive powers which it contained, the next moment, *viz.* when deprived of the living principle, is itself capable of being digested, either by the digestive powers of other stomachs, or by the remains of that power which it had of digesting other things.

From these observations, we are led to account for an appearance which we find often in the stomachs of dead bodies; and at the same time they throw a considerable light upon the nature of digestion. The appearance which has been hinted at, is a dissolution of the stomach at its great extremity; in consequence of which, there is frequently a considerable aperture made in that *viscus*. The edges of this opening appear to be half dissolved, very much like that kind of dissolution which fleshy parts undergo when half digested in a living stomach, or when dissolved by a caustic alkali, *viz.* pulpy, tender, and ragged.

In these cases the contents of the stomach are generally found loose in the cavity of the *abdomen*, about the spleen and diaphragm. In many subjects this digestive power extends much further than through the stomach. I have often found, that after it had dissolved the stomach at the usual place, the contents of the stomach had come into contact with the spleen and diaphragm,

had partly dissolved the adjacent side of the spleen, and had dissolved the diaphragm quite through; so that the contents of the stomach were found in the cavity of the *thorax*, and had even affected the lungs in a small degree.

There are very few dead bodies, in which the stomach is not, at its great end, in some degree digested; and one who is acquainted with dissections, can easily trace the gradations from the smallest to the greatest.

To be sensible of this effect, nothing more is necessary, than to compare the inner surface of the great end of the stomach, with any other part of the inner surface; what is found, will appear soft, spongy, and granulated, and without distinct blood vessels, opaque and thick; while the other will appear smooth, thin, and more transparent; and the vessels will be seen ramifying in its substance, and upon squeezing the blood which they contain from the larger branches to the smaller, it will be found to pass out at the digested ends of the vessels, and appear like drops on the inner surface.

These appearances I had often seen, and I do suppose that they had been seen by others; but I was at a loss to account for them; at first, I supposed them to have been produced during life, and was therefore disposed to look upon them as the cause of death; but I never found that they had any connection with the symptoms: and I was still more at a loss to account for these appearances when I found that they were most frequent in those who died of violent deaths, which made

me suspect that the true cause was not even imagined*.

At this time I was making many experiments upon digestion, on different animals, all of which were killed, at different times, after being fed with different kinds of food; some of them were not opened immediately after death, and in some of them I found the appearances above described in the stomach. For, pursuing the enquiry about digestion, I got the stomachs of a vast variety of fish, which all die of violent deaths, and all may be said to die in perfect health, and with their stomach commonly full; in these animals we see the progress of digestion most distinctly; for as they swallow their food whole, that is, without mastication, and swallow fish that are much larger than

* The first time that I had occasion to observe this appearance in such as died of violence and suddenly, and in whom therefore I could not easily suppose it to be the effect of disease in the living body, was in a man who had his skull fractured and was killed outright by one blow of a poker. Just before this accident, he had been in perfect health, and had taken a hearty supper of cold meat, cheese, bread, and ale. Upon opening the *abdomen*, I found that the stomach, though it still contained a good deal, was dissolved at its great end, and a considerable part of these its contents lay loose in the general cavity of the belly. This appearance puzzled me very much. The second time was at St. George's Hospital, in a man who died a few hours after receiving a blow on his head, which fractured his skull likewise. From those two cases, among other conjectures about so strange an appearance, I began to suspect that it might be peculiar to cases of fractured skulls; and therefore, whenever I had an opportunity, I examined the stomach in every person who died of that accident: but I found many of them which had not this appearance. Afterwards I met with it in a soldier who had been hanged.

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the digesting part of the stomach can contain (the shape of the fish swallowed being very favourable for this enquiry,) we find in many instances that the part of the swallowed fish which is lodged in the digesting part of the stomach is more or less dissolved, while that part which remains in the *œsophagus* is perfectly sound.

And in many of these I found, that this digesting part of the stomach was itself reduced to the same dissolved state as the digested part of the food.

Being employed upon this subject, and therefore enabled to account more readily for appearances which had any connection with it, and observing that the half-dissolved parts of the stomach, &c. were similar to the half-digested food, it immediately struck me that it was from the process of digestion going on after death, that the stomach, being dead, was no longer capable of resisting the powers of that menstruum, which itself had formed for the digestion of its contents; with this idea, I set about making experiments to produce these appearances at pleasure, which would have taught us how long the animal ought to live after feeding, and how long it should remain after death before it is opened; and above all, to find out the method of producing the greatest digestive power in the living stomach: but this pursuit led me into an unbounded field.

These appearances throw considerable light on the principles of digestion; they shew that it is not mechanical power, nor contractions of the stomach, nor heat, but something secreted in the coats of the stomach,

stomach, which is thrown into its cavity, and there animalises the food *, or assimilates it to the nature of the blood. The power of this juice is confined or limited to certain substances, especially of the vegetable and animal kingdoms ; and although this menstruum is capable of acting independently of the stomach, yet it is obliged to that *viscus* for its continuance.

* In all the animals, whether carnivorous or not, upon which I made observations or experiments to discover whether or not there was an acid in the stomach, (and I tried this in a great variety,) I constantly found that there was an acid, but not a strong one, in the juices contained in that *viscus* in a natural state.